Is it Safe?

DESCRIPTION
This lesson guide integrates a series of activities designed to look at how we are protected from the Sun's atmosphere.

OBJECTIVES
Students will:

- Contrast the geologic features of Venus and Mars with Earth in terms of protection from solar radiation
- Employ data about Solar emissions to produce a Space Weather news cast

NASA SUMMER OF INNOVATION

UNIT
Earth and Space Science – Universe

GRADE LEVELS
7th – 9th

CONNECTION TO CURRICULUM
Science and Technology

TEACHER PREPARATION TIME
1 hour

LESSON TIME NEEDED
4 hours *Complexity: Moderate*

NATIONAL STANDARDS

National Science Education Standards (NSTA)
Science as Inquiry
• Skills necessary to become independent inquirers about the natural world
• An appreciation of 'how we know' what we know in science

Physical Science
• Interactions of energy and matter
• Transfer of energy

Earth and Space Science
• Earth in the Solar System

History and Nature of Science
• Science as a human endeavor

ISTE NETS Performance Indicators for Students (ISTE)
Research and Information Fluency
• process data and report results

Critical Thinking, Problem Solving and Decision Making
• collect and analyze data to Identify solutions and or make informed decisions

MANAGEMENT

This set of activities requires computers with access to the internet. If multiple computers are not available for the Space Weather Activity Center exercises, pre-printing graphics from the space weather media viewer is suggested. If making space weather videos, it is recommended to do filming in another room to reduce distractions and extraneous noises.

CONTENT RESEARCH

The outermost atmosphere of the Sun extends well beyond the orbit of Mars. Because it lies within this layer, the Earth is subject to occasional solar events which cause fluctuations in the density of solar radiation. The atmosphere and magnetic field of the Earth protect the surface from this radiation so that life as we know it may exist. Highly energetic events can cause disruptions in satellite systems and cause auroras.

Key Terms

- **Aurora** – light radiated by excited atoms in the upper atmosphere, generally in the polar regions
- **Corona –** the outermost layer of the Sun's atmosphere
- **Coronal Mass Ejection** – a huge cloud of hot plasma occasionally ejected from the Sun
- **Heliosphere** – the entire region of space influenced by the Sun and its magnetic field

Misconceptions – Students often think that the Sun only sends us light and heat when, in fact, we are also constantly bombarded by additional radiation from the Sun that is blocked by the Earth's magnetic field and atmosphere.

MATERIALS

- Drawing Supplies (colored pencils or crayons)
- 3 ring binder
- Pencils
- Scissors
- 20 pocket style sheet protectors
- 4 clipboards
- 4 composition style notebooks
- Science display board
- Styrofoam ball
- Package of Pipe Cleaners (multi-colored)
- Glue sticks
- Heavy duty Velcro
- Paperclips
- Felt Markers (multiple colors)
- Yarn

LESSON ACTIVITIES

The suggested sequence introduces students to the geologic features which protect life on Earth from Solar radiation and then leads students to study the daily fluctuations in the Solar atmosphere to produce a Space Weather report.

Astroventure Geology Mission
Students explore the roles of various geologists as they compare the geology of Earth, Mars and Venus in an online tutorial and activity.
http://www.astroventure.arc.nasa.gov/geology/mission/index.html

Space Weather Action Centers
Students investigate solar storms and their effect on the Earth to produce a space weather daily report.
http://sunearthday.nasa.gov/swac/

ADDITIONAL RESOURCES

The Zooniverse website has multiple activities for students to explore space including Solar Stormwatch.
http://www.zooniverse.org/home

DISCUSSION QUESTIONS

Each activity includes questions for discussion.
Additional questions:

- Why are we concerned with Space Weather? *The radiation emitted by the Sun could affect life on Earth and damage satellites.*
- How do we protect astronauts from Coronal Mass Ejections? *They go to a specially shielded portion of their spacecraft.*

ASSESSMENT ACTIVITIES

Each activity has a series of questions in the student pages.

Pretest / Posttest questions:

- Name two ways that the Earth is protected from space weather**.** *Magnetic field, Atmosphere*
- Name at least two of the satellites we use to study the Sun. *SOHO, STEREO, Hinode, SDO*
- Why do we observe the Sun in multiple parts of the spectrum**?** *We learn different things from different parts of the spectrum.*

ENRICHMENT

- Have students produce a daily space weather update.
- Have students design a mission to study the Sun and describe what parts of the spectrum they choose to observe and why.